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CIA/OER/IM 71-107

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DIRECTORATE OF
INTELLIGENCE

Intelligence Memorandum

Expenditures On The French Nuclear Program

Secret

ER IM 71-107
June 1971

Copy No. 59

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
June 1971

INTELLIGENCE MEMORANDUM

EXPENDITURES ON THE FRENCH NUCLEAR PROGRAM

Introduction

1. French government spokesmen have indicated that the present regime contemplates no significant departures from goals and programs set previously for developing nuclear weapons. Nuclear budgets for 1971 and 1971-75 appear to confirm these statements. Construction of nuclear powerplants, however, is scheduled to expand considerably. This memorandum compares nuclear expenditures envisioned under current plans with expenditures made through 1970 and in recent years. It estimates the total cost of the French nuclear program to date and analyzes the costs of individual phases of the program.

Discussion

Nuclear Spending in 1971

2. In 1971, France will spend almost $1 billion on its nuclear program. The figure for 1971 continues a declining trend evident since 1967 and is the smallest annual amount (in francs) 1/ to be spent since 1964. Expenditures in 1971 are expected to be about 3% below those of 1970 and about 22% less than those of 1967. 2/ This appears, however, to be

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1. Data in this memorandum were developed in francs. On 1 January 1960 a new franc equal to 100 old francs was introduced. Data in old francs were converted to new francs at this rate. Data in new francs were converted at the par value of 4.93706 francs per US dollar through July 1969. Data from that time on were converted at a new par value of 5.55419 francs per US dollar.

2. In terms of dollars the decrease relative to 1967 would be greater, about 30%.

Note: This memorandum was prepared by the Office of Economic Research and coordinated within CIA.

the last year of decline, as military spending is scheduled to rise again starting in 1972 and spending for the nuclear electric power program also will increase.

3. The military nuclear budget 3/ for 1971 – $422 million – is the smallest since 1963. Within the military allocation, the budget for tactical weapons, $81 million, is more than twice the amount allocated in 1970.

4. The 1971 budget for the CEA (Commissariat a l'Energie Atomique – the French Atomic Energy Commission) of $290 million is more than 10% below that for 1970. The CEA's own revenues from sales of nuclear materials and research services are expected to increase, but total funds available to the CEA still will be 5% smaller in 1971 than in 1970.

Nuclear Spending Through 1970

5. Cumulative nuclear expenditures from 1946 through 1970 amount to more than $11 billion, divided about equally between capital investment and operating expenses. Annual spending increased rapidly during the early years of the program, rising from roughly $1 million in 1946 to more than $1 billion in 1964. It reached a peak of $1.4 billion in 1967 and has since been declining gradually (see Figure 1).

6. Most funds for the nuclear program have come from the national budget. Through 1970, funds from the budgets of the armed forces accounted for 46% of all nuclear spending. Budgetary allocations for the CEA accounted for approximately 35% and those for international organizations for 3%. Amounts spent by the EdF (Electricite de France – the state-owned electric power company) and by private enterprises together accounted for 11%, and funds earned by the CEA made up only about 5%. Estimated expenditures on the French nuclear program and sources of funds are shown in Table 1.

7. The CEA actually administers about 80% of all nuclear spending because most nuclear funds budgeted for the armed forces are transferred to the CEA for use on specific military projects. These include the production and testing of weapons (including research, development, and fabrication); the production of tritium, lithium, and enriched uranium; and the development of propulsion reactors for nuclear submarines.

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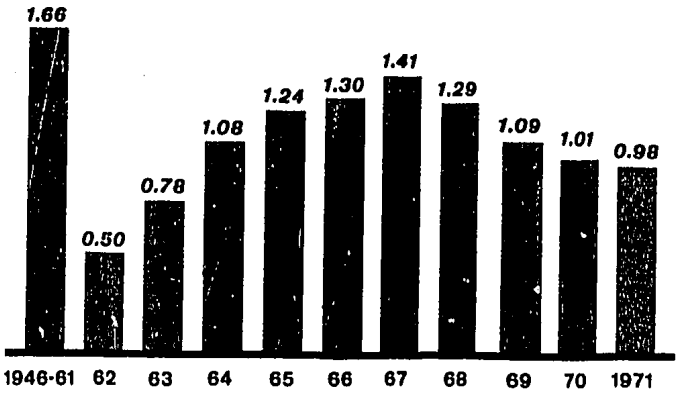
3. Military nuclear spending as discussed in his memorandum covers only facilities and activities related to the production and testing of nuclear weapons and to the development of a nuclear propulsion system for submarines. Expenditures on delivery systems for nuclear weapons – the Mirage IV bombers, the land-based IRBMs, and the missile-launching submarines – are not included.

Annual Expenditures on the French Nuclear Program
Billion US $

Figure 1



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8. The cost of producing plutonium, which so far has been used only for military purposes, appears, however, to have been borne by the CEA with only a small contribution from the military. The CEA also uses its own funds to cover administrative costs, costs of some production activities, and expenditures for nonmilitary research. During the past several years, the largest block of research funds has been spent for studies related to the production of energy. The CEA is responsible for developing power reactors up to the point where they are considered ready for commercial use. The EdF then takes over responsibility for building and operating them, but continues to depend on CEA for research to perfect and improve the systems. The EdF reimburses the CEA for such research.

9. Funds spent directly by the armed forces, about 6% of total nuclear expenditures, are used principally for testing. Private investment has been concentrated primarily in facilities for mining and processing uranium ore, but there also has been private spending for equipment and research in the nuclear field. Two auxiliary plants of the Pierrelatte gaseous diffusion plant – the Pierrelatte Chemical Plant, which produces uranium hexafluoride feedstock, and the barrier plant – are privately owned, but the amount invested in these plants is not known. Expenditures by the EdF for nuclear activities have gone for research, construction, and operation of powerplants.

Table 1

Estimated Expenditures on the French Nuclear Program a/

Years	Source of Funds (Million US $) CEA b/	Armed Forces c/	International Organizations	EdF and Other	Total	Total as Percent of GNP d/
1946-65	2,430	2,100	200	530	5,260	
1966	390	740	40	130	1,300	1.2
1967	460	770	40	140	1,410	1.2
1968	440	660	35	155	1,290	1.0
1969	330	510	40	150	1,090	0.8
1970	375	460	25	150	1,010	0.7
Total	*4,435*	*5,240*	*380*	*1,255*	*11,360*	
1971	360	440	20	160	980	0.6
Total	*4,895*	*5,680*	*400*	*1,415*	*12,340*	

a. So far as possible, budget figures used in compiling these estimates are those for appropriations (credits de paiement) rather than authorisations (authorisations de programme). The estimates should be regarded as low. Not all private investments are known, and it is not possible to detect all budget categories that may have some nuclear content. Moreover, data reported for some military budget categories for 1969, 1970, and 1971 apparently are less inclusive than those for earlier years.

b. Budgeted funds plus earnings by the CEA. In the years 1966-71, net of loan repayments to the Fund for Economic and Social Development. These obligations were incurred for investment in facilities for research during 1956-66.

c. Funds specifically budgeted for nuclear programs plus estimates of support funds from the operating budgets of the various armed forces. These estimates, a relatively small part of the total, are based on partial data reported for some years in official French government publications.

d. Based on GNP in current prices (provisional for 1970; estimated for 1971).

10. Investments in the nuclear program have been distributed throughout the country (see Figure 2), partly because of a stated national policy of creating employment in various regions. The geographic locations of major nuclear investments through 1968 are as follows:

	Million US $
Pierrelatte	1,080
Marcoule	240
La Hague	140
Saclay	290
Cadarache	250
Fontenay-aux-Roses	90
Grenoble	70
Brennilis	80
Chinon	300
St. Laurent	250
Bugey	60

In addition, large investments have been made abroad – in the powerplants at Chooz and Tihange in Belgium and at Vandellos in Spain and in test sites in the Sahara and the South Pacific. Investment in the Pacific totaled nearly $800 million through 1970.

11. Between 1964 and 1968, France was spending 1% or more of its GNP on nuclear programs. In 1965 the share was about 1.3%. It had dropped again to only about 0.8% by 1969 and declined further in 1970 to about 0.7%. For a country developing an independent nuclear weapons capability, these percentages do not represent an abnormally large share of national resources.

Expenditures for Military Purposes

12. Nearly $7.5 billion, about 65% of all nuclear spending through 1970, has gone into the military program (see Figure 3). About $6 billion has been spent directly for purely military projects. The remainder is the estimated military share of projects that have both military and nonmilitary aspects. These shares may be broken down as follows (in percent of total spending):

Direct military expenditures	
Weapons research, development, and fabrication (including production of lithium and tritium)	21
Weapons testing	13
Pierrelatte gaseous diffusion plant	14
Plutonium production (including costs of reactors at Marcoule)	5
Heavy water	Negl.
Estimated military share of combined expenditures	
Production (mining and processing uranium)	3
Research	6
Administration	3
Total	*65*

Expenditures for Nonmilitary Purposes

13. Through 1970 the CEA had spent about $2.5 billion for activities serving mainly nonmilitary applications of atomic energy, such as the development of nuclear electric power and industrial and scientific uses. The EdF spent more than $900 million for the construction and operation of nuclear powerplants, and an estimated $300 million was invested in privately owned facilities. The distribution of nuclear expenditures by function is shown in Table 2.

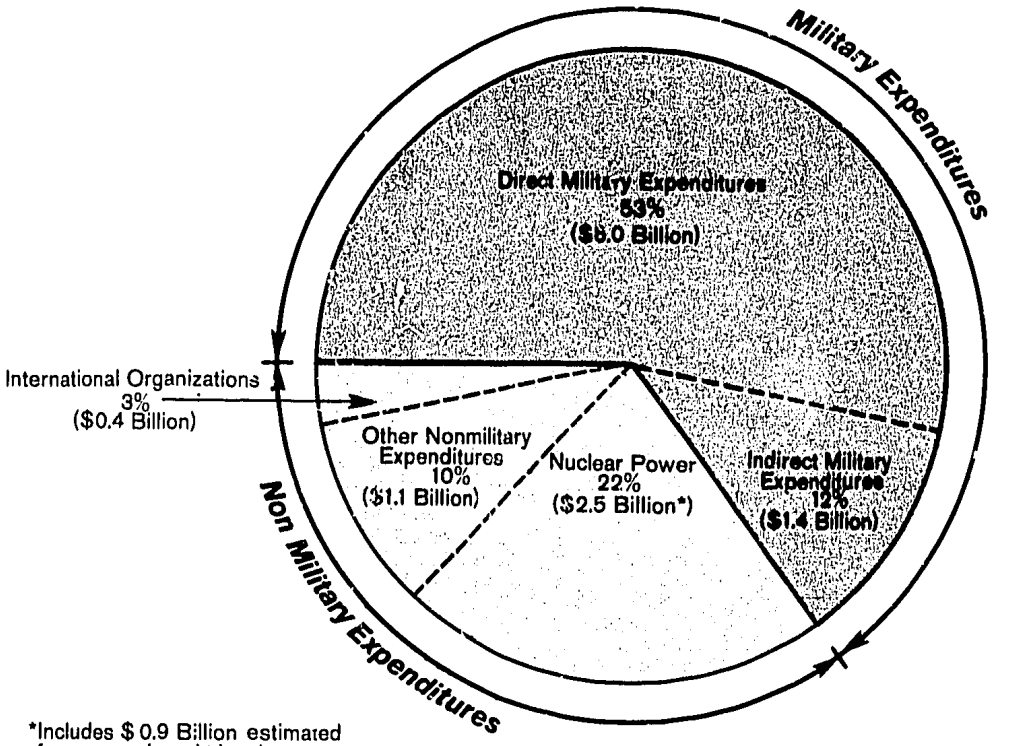
Patterns of Nuclear Spending Since 1967

14. Spending on the French nuclear program has declined since 1967, to some extent because nationwide austerity measures were instituted after the disturbances of May 1968 but largely because several major investment projects have been completed. Military expenditures in 1970 were 35% below those of 1967; CEA expenditures were 13% less. EdF investments have been stabilized at around 510-530 million francs per year for the past four or five years.

15. Spending for production activities (mining, ore concentration, and the production of reactor fuels, heavy water, enriched uranium, and plutonium) has declined since 1967. Increased spending for exploration and

Figure 3

Distribution of French Nuclear Expenditures, 1946-70



*Includes $ 0.9 Billion estimated for research and development

Total Expenditures $11.4 Billion

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mining has been more than offset by the decline in investment resulting from completion of such major production facilities as the uranium enrichment plant at Pierrelatte and the plutonium separation plant at Cap de la Hague.

16. Expenditures for nuclear testing dropped sharply in 1969, when the test series was canceled for economic and political reasons. In spite of an increase in 1970, they remained lower than in previous years because test installations have been largely completed and some safety precautions and monitoring operations have been eliminated as unnecessary.

Table 2

Functional Distribution of Estimated Expenditures on the French Nuclear Program
1946-70

	Capital Investment		Operating Expenditure		Total	
	Million US $	Percent of Total a/	Million US $	Percent of Total a/	Million US $	Percent of Total a/
CEA administration	100	1.6	680	12.5	780	6.9
Exploration and mining	160	2.8	410	7.5	570	5.0
Ore concentration	20	0.3	120	2.2	140	1.2
Feed materials	70	1.1	290	5.3	360	3.2
Heavy water	15	0.3	20	0.3	35	0.3
Gaseous diffusion	1,080	18.1	460	8.6	1,540	13.6
Plutonium separation	260	4.4	150	2.8	410	3.6
CEA reactors	100	1.6	15	0.3	115	1.0
EdF reactors	895	15.2	45	0.8	940	8.3
CEA research b/	960	16.3	1,210	22.2	2,170	19.1
Weapons research, development, and fabrication c/	1,320	22.3	1,100	20.4	2,420	21.3
Weapons testing	940	16.0	560	10.2	1,500	13.2
International organizations	--	--	380	6.9	380	3.3
Total	*5,920*	*100.0*	*5,440*	*100.0*	*11,360*	*100.0*

a. Percentages are based on figures in francs.
b. For the period 1966-70, CEA total research expenditures were broken down approximately as follows: energy studies, 32%; production studies, 9%; basic research, 23%; studies of radioelements, 3%; protection and safety studies, 5%; other applied research, 3%; and technical support, 25%.
c. Including production of lithium and tritium and probably heavy water.

17. Expenditures for research by the CEA have been increasing as a share of total expenditure. Funds for work on fast-breeder reactors have been increased, while those for other reactor work, basic research, and technical support have been cut back.

Indications of Future Nuclear Spending

Armed Forces

18. The military Program Law adopted for the period 1971-75 provides for nuclear expenditures totaling $2.6 billion, about 5% below the amount allocated during 1966-70. Although the annual authorizations are to increase from $418 million in 1971 to $551 million in 1974 and 1975, the share of nuclear spending in total military budgets, in total national budgets, and in GNP will decline.

19. Spending for tactical nuclear weapons is scheduled to reach a peak of $118 million in 1972. Expenditures on nuclear testing are expected to decline because the annual number of tests is to decrease and it was announced in the summer of 1970 that two of the three firing sites in the Pacific may be closed down.

Commissariat a l'Energie Atomique

20. Spending by the CEA probably will continue to decline. Budget allocations almost certainly will not be increased. The number of CEA personnel, which had reached more than 30,000 by 1969, is to be cut by 2,600 by the end of 1971, and some activities, especially in the military program, are being curtailed because they no longer are needed on the previous scale. Production activities are expected to sustain the largest cuts in spending, including those resulting from closing down the uranium processing plant at Le Bouchet. Research costs, however, will be maintained at only slightly reduced levels, largely because work on fast-breeder reactors is to be increased. About $36 million per year is to be spent on development of a fast-breeder prototype during the next two or three years. The EdF is contributing one-fifth of the funds for this work.

21. In the future, more of the money spent by the CEA is expected to come from increased sales of materials and services and less from budgetary sources. For some years the CEA has received income from sales of radioelements for scientific use, from sales of fuel elements to the EdF, and from research performed for the EdF and for foreign or international agencies. Such earnings were expected to total about $72 million in 1970 and $86 million in 1971. In August 1969 a company called Uranex, in

which the CEA has a one-third interest, was formed to promote sales of uranium abroad. So far, this company has reported sales to Sweden, Japan, Belgium, and the Netherlands, but amounts of the sales are not known. Another company with 30% CEA participation, Comurhex, formed in September 1970 to produce uranium hexafluoride, will include in its operations the conversion of foreign-owned uranium to hexafluoride on contract.

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22. According to a decree of September 1970, the CEMA has been authorized to extend research and development activities into non-nuclear fields. Work of this sort done on contract for industry or for other parts of the government will provide an additional source of revenue. In May 1971, for example, the CEA signed a contract to do research for Peugeot and Renault in the fields of metallurgy, corrosion, and waste treatment.

23. If the French proceed with their intention, announced in February 1971, to build a plant for commercial enrichment of uranium on a scale sufficient to cover European needs, this plant will provide additional income in the long run. The plant cannot be started before 1974, however, and investment costs will be high – $500-$700 million. Financial participation by other countries is hoped for. If the plant is built by France alone, the government probably will encourage a high level of private investment.

24. The French claim that the proposed plant, unlike the present enrichment plant at Pierrelatte, will be able to produce enriched uranium at competitive prices. A figure of around $28 per unit of separative work has been mentioned. It appears that both a low profit margin and a power subsidy will be necessary if French enriched uranium is to be offered at this price. The figure reportedly was calculated on the basis of a unit of cost of electric power, the most expensive element in toll enrichment, of 5 mills per kilowatt-hour. The Pierrelatte plant now is paying 8-9 mills. The United States, which for years charged $26 per unit of separative work, increased the price to $28.70 in February 1971 and announced a further increase to $32 effective September 1971. The main reason cited for these increases is the rise in the cost of power from 4 mills per kilowatt-hour to an expected average of 5.2 mills.

Electricite de France

25. Five powerplants already under construction are scheduled for completion by 1975, and a decision of the Council of Ministers in February 1971 calls for construction to start before 1975 on eight to ten additional

plants with a total capacity of 8,000 megawatts. The cost of the first of these plants, which is to have a capacity of 850 megawatts, is to be around $200 million. Accordingly, 8,000 megawatts of capacity may be expected to approach a cost of $2 billion. A considerable portion of this will be spent after 1975, but if even half is spent during 1971-75, EdF's nuclear investments during the period will be about double those of 1966-70.

26. One reason for expanding the construction of nuclear powerplants on such a large scale was a growing uncertainty regarding future supplies and costs of oil. Another was the desire to give French industry experience in building reactors of types saleable abroad. Although the French contend that their gas-graphite reactors could be competitive, there is no international demand for them because US light-water reactors have become the accepted types on the world market. Plants to be built under the current French program are to employ US technology. Both the Westinghouse pressurized-water system and the General Electric boiling-water system will be used, so that French firms can gain experience with each type.

Conclusions

27. Nuclear spending in 1971, which will amount to almost $1 billion, is the smallest since 1964 and continues a downward trend evident since 1967. The decline in annual spending has resulted to some extent from nationwide economy measures instituted after the riots of May 1968 but largely from the fact that the most expensive military investment projects in the nuclear field have been completed. Total nuclear spending through 1971 will amount to more than $12 billion.

28. Nuclear expenditures will start to rise again in 1972. The military share, which amounted to about 65% through 1970, probably will decline, because as indicated, the heavy spending phase of the military program has passed. Spending for nuclear powerplants is scheduled to rise rapidly during the next few years and will represent a larger share of total nuclear expenditures.

29. The role of the CEA is changing. As the need for direct CEA support to the military nuclear program decreases, the funds transferred from military budgets also will be reduced. Activities and personnel of the CEA already are being cut back, and its efforts, especially in research, are being gradually redirected toward nonmilitary and even nonnuclear projects. At the same time, the CEA is entering increasingly into commercial operations to obtain additional income, even though budget allocations will continue to be the main source of funds.